

Occurrence of an egg mass of *Thysanoteuthis rhombus* (Cephalopoda: Teuthida) in the Strait of Messina (Italy), locus typicus of the species

Vinicio Biagi (†)* & Giambattista Bello (✉)#

* Via Indipendenza 143,
57029 Venturina (Li), Italy

Arion, C.P. 61, 70042
Mola di Bari, Italy,
giabello@libero.it

(✉) Corresponding
Author

Abstract

An egg mass of the diamond-shaped squid, *Thysanoteuthis rhombus* (Cephalopoda: Teuthida), was found in the harbour of Reggio Calabria (Strait of Messina). It was 60 cm long and was estimated to contain 15,000 eggs. A general description of *T. rhombus* egg masses is reported. An account of former occurrences of such egg masses in the Mediterranean is given. The Strait of Messina is the *locus typicus* of *T. rhombus*; the first described egg mass was also collected there. This peculiar marine district is hypothesized to be a preferential spawning area for this squid.

Riassunto

Viene segnalato il ritrovamento di un nidamento di totano rombo, *Thysanoteuthis rhombus* (Cephalopoda: Teuthida), nel porto di Reggio Calabria (Stretto di Messina, Mediterraneo). Si è stimato che il nidamento, lungo 60 cm circa, contenesse 15.000 uova. In aggiunta alla descrizione generale degli ammassi ovigeri di *T. rhombus*, vengono riassunti i loro precedenti ritrovamenti mediterranei. Lo Stretto di Messina rappresenta il *locus typicus* della specie, nonché il luogo dove fu rinvenuto il primo nidamento della stessa specie riportato in letteratura. Si ipotizza che lo Stretto, grazie alle sue peculiarità idrodinamiche, costituisca un sito preferenziale per la deposizione di uova da parte di *T. rhombus*.

Key words

Cephalopoda, Thysanoteuthidae, egg mass, Strait of Messina, Mediterranean Sea.

Introduction

The diamond-shaped squid, *Thysanoteuthis rhombus* Troschel, 1857 (Cephalopoda: Teuthida: Thysanoteuthidae), is an epipelagic oceanic species living in warm and temperate waters of the world ocean, including the Mediterranean Sea (Clarke, 1966). It is a fairly large species, one of the largest squid in the Mediterranean; it reaches at least 100 cm in mantle length (ML) and 20 kg in weight (Roper et al., 1984). This squid is comparatively common in the Mediterranean (see review in Bello, 1999 and 2009). In the Italian waters, several large specimens have been caught by sport fishermen by means of fishing-line (Biagi, 1992), whereas subadults and juveniles have been netted by *ciunciolo*, a type of purse-seine for blue fish (Biagi, 1982 and pers. obs.).

Thysanoteuthis rhombus was first described on a specimen collected in the Strait of Messina (Troschel, 1857), a channel connecting the Tyrrhenian to the Ionian Sea, which is the Mediterranean site that has provided the most copious wealth of oceanic species.

The first egg mass of *T. rhombus* to be described was also collected in the Messina Strait (Sanzo, 1929). This description, in addition to the egg mass gross morphology, includes egg capsules and embryos; the identification to *T. rhombus* was based upon the examination of embryos and hatchlings (Sanzo, 1929). Half a century later, some fifteen egg masses of *T. rhombus* had been reported from the tropical and subtropical waters of the Atlantic and Pacific Oceans. As for the Mediterranean, a second egg mass was described by Guerra & Rocha (1997); it was

collected about 160 km south of Formentera (Balearic Islands) and about 80 km off the Algerian coast; finally, Guerra et al. (2002) reported three more egg masses from the Mediterranean westernmost areas: two of them from the Alboran Sea off the Spanish coast and one farther east, off Cartagena (Murcia).

The description of *T. rhombus* egg masses reported in several works (e.g. Billings et al., 2000; Guerra et al., 2002) may be summarized thus: sausage-shaped, sometimes folded up or spirally coiled; length 60 to 200 cm; diameter 10 to 30 cm; texture gelatinous, dense, and elastic; egg capsules purple-coloured, arranged in two parallel and closely spaced coiled lines in the outermost layer of the mass; each capsule containing a single egg. Nigmatullin et al. (1995) hypothesized that females have either one of two different ways of spawning such a peculiar egg mass, so far unique among cephalopods (Fig. 1). The number of eggs in each mass is proportionate to its size; estimates from examined masses range from 35,000 to 180,000 eggs (Billings et al., 2000; Guerra et al., 2002). The egg masses, obviously devoid of any motion of their own, seem to be neutrally buoyant and fit into the megaplankton. All the diamond-shaped squid egg masses reported so far have been observed or collected close to the sea surface.

Much information on the reproductive biology of *T. rhombus* is reported by Arkhipkin et al. (1983), Sabirov et al. (1987) and Nigmatullin et al. (1991, 1995).

In this paper, we report the finding of a *T. rhombus* egg mass in the harbour of Reggio Calabria, on the eastern coast of the Messina Strait. This is the second report of

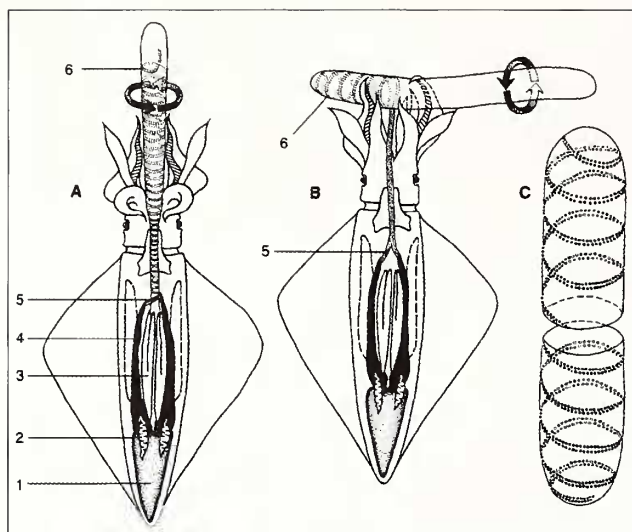


Fig. 1. *Thysanoteuthis rhombus*. **A** and **B**: two possible ways of egg mass construction by females. **C**: schematic diagram of egg mass: 1: ovary; 2: oviduct; 3: nidamental glands; 4: oviductal glands; 5: secretion of oviductal glands with ripe eggs; 6: egg mass (after Nigmatullin et al., 1995: p. 85).

Fig. 1. *Thysanoteuthis rhombus*. **A** e **B**: possibili alternative di produzione del nidamento da parte della femmina. **C**: disegno schematico di nidamento. 1: ovario; 2: ovidutto; 3: ghiandole nidamentali; 4: ghiandole dell'ovidutto; 5: secrezione delle ghiandole dell'ovidutto contenente le uova mature; 6: nidamento (da Nigmatullin et al., 1995: p. 85).

such egg masses in Italian waters and in the central Mediterranean and the sixth report in the whole Mediterranean basin. In addition to these findings, there are two photographic records of such egg masses in the website www.mondomarino.net: a photo by Guido Picchetti labelled "Calamaro: uova (*Thysanoteuthis rhombus*)" ["Squid: eggs (*Thysanoteuthis rhombus*)"] and a set of three photos by Alberto Romeo labelled "Calamaro: uova planctoniche (*Thysanoteuthis rhombus*)" ["Squid: planktonic eggs (*Thysanoteuthis rhombus*)"]; these photos were taken in the waters of the Sicilian islands of Pantelleria and Ustica respectively.

Material and results

The egg mass was observed in the harbour of Reggio Calabria passively floating just below the sea surface, in late spring 2003. Its estimated length upon close observation was 60 cm. An attempt to collect the mass with a dip net was unsuccessful; however it showed that the seemingly gelatinous egg mass was firm and heavy, thus suggesting that it was solid.

Just below the whole mass surface there were small round structures, about 3 mm in diameter, arranged in transverse coils with respect to the longitudinal axis of the cylindrical mass. A jellyfish, *Pelagia noctiluca* (Forskål, 1775), adhered to the egg mass surface. A photograph of the egg mass taken perpendicularly to it (Fig. 2) allows the following remarks.

Size: the cylinder diameter is estimated at 15 cm, based on its length = 60 cm. Its surface, calculated by the formula

(where σ and h are diameter and length of the cylinder, respectively), is about 2,800 cm²; the volume, calculated by the formula

$$V = \pi (\sigma/2)^2 h$$

is about 10,600 cm³; based on the neutral buoyancy of the egg mass and the density of sea water, the estimated weight of the egg mass is somewhat more than 10 kg. Lastly, using the data by Guerra et al. (2002: table I), we calculated that *T. rhombus* egg masses bear on average 5.3 eggs/cm² surface. According to such a density value, the estimated number of eggs of the mass described herein is about 15,000.

Colour: the egg mass is transparent, but the capsules are dark red to purple and give an overall pinkish coloration to the mass. In some areas of the cylinder, the double line of spirally coiled egg capsules is clearly evident.

Discussion

The egg mass of *Thysanoteuthis rhombus* described in this report was found in the Messina Strait, *locus typicus* of the species (Troschel, 1857), where an egg mass of the same species was first recorded (Sanzo, 1929). In the past centuries many new species, mostly deep pelagic, have been discovered in the Messina Strait thanks to the strong tidal currents, which run alternatively from the north to the south and *vice versa*, and to the up-welling (Mazzarelli, 1909). The occurrence of a *T. rhombus* egg mass in the harbour of Reggio Calabria, which is U-shaped and widely open to the north, is probably due to such currents. Guerra et al. (2002) hypothesized that *T. rhombus* lays its eggs in waters with strong currents, such as the westernmost Mediterranean area.

We maintain that another factor is important in the selection of the spawning site, that is food availability (see also Miyahara et al., 2006). This squid grows rather fast, especially when adequate quantities of food are available (Nigmatullin et al., 1995). Arkhipkin & Nigmatullin (1997) showed that the modes of life and reproduction of some teuthids are strongly linked to food availability at different stages of their biological cycle (in addition to protection from potential predators); the Messina Strait with its strong upwelling phenomena can satisfy the feeding needs of early juvenile *T. rhombus*. Incidentally, many other species with high growth rates at their early stages, such as the swordfish, reproduce preferentially in areas with strong upwelling such as the Messina Strait (Bello, 1984). Moreover, the reports of reproductive pairs from this area (Biagi, 1992; Giordano et al., 1998; Bello, 1999) further support that the Messina Strait is one of the breeding sites for *T. rhombus* (this is the only cephalopod known to form stable breeding pairs all along the reproductive period, during which "pulsating" or "multiple" spawning occurs [Nigmatullin et al., 1995]). Pairs of diamond-shaped squid have also been reported in other Mediterranean locations, such as the Aegean Sea (Vardala-Theodorou et al., 1991); paired unsexed adult specimens (Templado & Luque in Guerra, 1992; Jereb &



Fig. 2. *Thysanoteuthis rhombus* egg mass observed in the harbour of Reggio Calabria (southern Italy) (photo by G. Rizzica).

Fig. 2. Nidamento di *Thysanoteuthis rhombus* osservato nel porto di Reggio Calabria (foto G. Rizzica).

Ragonese, 1994) most probably represent reproductive pairs too. The finding of early juveniles in the southernmost Tyrrhenian Sea (Degner, 1925), fairly close to the Messina Strait, also supports the hypothesis that this is a preferential reproductive area.

The estimated number of eggs in the Reggio Calabria *T. rhombus* egg mass is the smallest ever reported. As regards the size of the egg mass and the number of egg-capsules, we suggest that the diameter of the egg mass might be related to the female size (see Nigmatullin et al., 1995), whereas its length is mainly due to the quantity of eggs laid and, in turn, to the quantity of mature oocytes stored in the oviducts. The latter are comparatively small and contain about 150,000 oocytes at the most, i.e., a small fraction of a female total oocyte production, which amounts to 3 to 5 million (Nigmatullin et al., 1995); as already pointed out here above, *T. rhombus* is a multiple spawner.

Acknowledgements

We thank our friend Guglielmo Rizzica for his report and photograph of the egg mass described in this work, and Dr. Andrea Biddittu for some valuable suggestions.

References

- ARKHIPKIN A.I. & NIGMATULLIN C.M., 1997. Ecology of the oceanic squid *Onychoteuthis banksi* and the relationship between the genera *Onychoteuthis* and *Chaunoteuthis* (Cephalopoda: Onychoteuthidae). *Journal of the Marine Biological Association of the United Kingdom*, **77**: 839-869.
- ARKHIPKIN A.I., NIGMATULLIN C.M., SABIROV R.M., SHILIN K.D., 1997. Sexual system morphology and peculiarities of functioning of squid *Thysanoteuthis rhombus*. In *Taxonomy and ecology of cephalopods*. Leningrad, Nauka Press: 59-61.
- BELLO G., 1984. Reflections on the genetic migrations of the swordfish, *Xiphias gladius* L. (Osteichthyes, Xiphiidae), in relation to water density. *Quaderni dell'Istituto di Idrobiologia e Acquacoltura "G. Brunelli"*, **4**: 3-15.
- BELLO G., 1999. New records of *Thysanoteuthis rhombus* (Cephalopoda, Thysanoteuthidae) in the Mediterranean Sea. *Bollettino Malacologico*, **34**: 125-128.
- BELLO G., 2009. On the presence of *Thysanoteuthis rhombus* (Cephalopoda: Thysanoteuthidae) in the Adriatic Sea. *Marine Biodiversity Records*, **2**, e154.
- BIAGI V., 1982. Sul rinvenimento di un giovane esemplare di *Thysanoteuthis rhombus* Troschel (Cephalopoda-Teuthoidea) in acque elbane. *Bollettino Malacologico*, **18**: 137-144.
- BIAGI V., 1992. I totani dei ciclopi. *Pesca in Mare*, **8** (11): 90-93.
- BILLINGS V.C., SULLIVAN M. & VINE H., 2000. Sighting of *Thysanoteuthis rhombus* egg mass in Indonesian waters and observations of embryonic development. *Journal of the Marine Biological Association of the United Kingdom*, **80**: 1139-1140.
- CLARKE M.R., 1966. A review of the systematics and ecology of oceanic squids. *Advances in Marine Biology*, **4**: 91-300.
- DEGNER E., 1925. Cephalopoda. *Reports of the Danish Oceanographic Expeditions 1908-10 to the Mediterranean and Adjacent Seas*, **2**, C. 1: 1-94.
- GIORDANO D., PERDICHIZZI F. & GRECO S., 1998. About a couple of *Thysanoteuthis rhombus* (Cephalopoda, Thysanoteuthidae) found in the Strait of Messina (Sicily). *Rapports et procès-verbaux des réunions, Commission internationale pour l'exploration scientifique de la Mer Méditerranée*, **35**: 436-437.
- GUERRA A., 1992. Mollusca, Cephalopoda. *Fauna Ibérica*. Madrid, Museo Nacional de Ciencias Naturales, CSIC, vol. 1, 327 pp.
- GUERRA A., GONZÁLEZ A., ROCHA F.J., SAGARMINAGA R. & CAÑADAS A., 2002. Planktonic egg masses of the diamond-shaped squid *Thysanoteuthis rhombus* in the eastern Atlantic and the Mediterranean Sea. *Journal of Plankton Research*, **24**: 333-338.
- GUERRA A. & ROCHA F., 1997. On a floating egg mass of the diamond shaped squid *Thysanoteuthis rhombus* (Cephalopoda: Thysanoteuthidae) in the western Mediterranean. *Iberus*, **15**: 125-130.
- JEREB P. & RAGONESE S., 1994. Su due grandi esemplari di *Thysanoteuthis rhombus* (Cephalopoda, Thysanoteuthidae), catturati a Mazara del Vallo (Canale di Sicilia, Mediterraneo Centrale). *Biologia Marina Mediterranea*, **1** (1): 289-290.

- MAZZARELLI G., 1909. Gli animali abissali e le correnti sottomarine dello Stretto di Messina. *Rivista Mensile di Pesca e Idrobiologia*, **11**: 177-218.
- MIYAHARA K., FUKUI K., OTA T. & MINAMI T., 2006. Laboratory observations on the early life stages of the diamond squid *Thysanoteuthis rhombus*. *Journal of Molluscan Studies*, **72**: 199-205.
- NIGMATULLIN C.M., ARKHIPKIN A.I. & SABIROV R.M., 1991. Structure of the reproductive system of the squid *Thysanoteuthis rhombus* (Cephalopoda: Oegospida). *Journal of Zoology*, **224**: 271-283.
- NIGMATULLIN C.M., ARKHIPKIN A.I. & SABIROV R.M., 1995. Age, growth and reproductive biology of diamond-shaped squid *Thysanoteuthis rhombus* (Oegopsida: Thysanoteuthidae). *Marine Ecology Progress Series*, **124**: 73-87.
- ROPER C.F.E., SWEENEY M.J. & NAUEN C.E., 1984. FAO species catalogue. Vol. 3. Cephalopods of the world. *FAO Fisheries Synopsis*, **125** (3): 1-277.
- SABIROV R.M., ARKHIPKIN A.I., TSYGANKOV V.Y. & SHCHETTINNIKOV A.S., 1987. Egg laying and embryonic development of diamond-shaped squid, *Thysanoteuthis rhombus* (Oegopsida: Thysanoteuthidae). *Zoologicheskii Zhurnal*, **66**: 1155-1163.
- SANZO L., 1929. Nidamento pelagico, uova e larve di *Thysanoteuthis rhombus* Troschel. *Memorie del Regio Comitato Talassografico Italiano*, **161**: 1-10.
- TROSCHER F.H., 1857. Bemerkungen über die Cephalopoden von Messina. *Archiv für Naturgeschichte*, **23**: 40-76.
- VARDALA-THEODOROU E., GIAMAS P. & DIMITROPOULOS A., 1991. A short notice on the occurrence of a pair of *Thysanoteuthis rhombus* Troschel, 1857 in southern Euboic Gulf. *Bollettino Malacologico*, **27**: 25-34.